PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-014705
(43)Date of publication of application : 19.01.1996

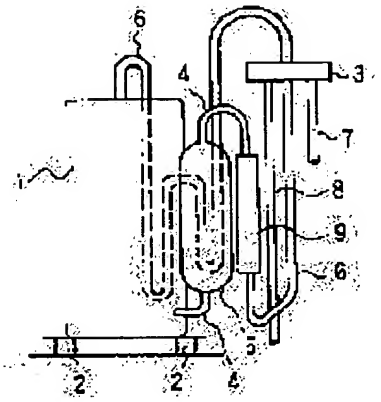
(51)Int.CI. F25B 41/00
F24F 5/00

(21)Application number : 06-143529
(22)Date of filing : 24.06.1994

(71)Applicant : MITSUBISHI ELECTRIC CORP
(72)Inventor : MOCHIZUKI ATSUSHI
NAGANO MASAO
SHIMIZU KATSUNORI
TEZUKA YOFUMI
ISOBE YUTAKA

(54) REFRIGERANT PIPE FOR AIR CONDITIONER

(57)Abstract:
PURPOSE: To provide a refrigerant pipe for an air conditioner at a low cost, which sufficiently absorbs vibrations of the refrigerant pipe connected to a compressor of the air conditioner, has sufficient strength for pressure resistance and a bending stress and can be made small in size.
CONSTITUTION: A flexible tube 9 made of stainless steel and formed into a bellows shape is connected in series to a refrigerant pipe on the way of the refrigerant pipe which is arranged between a compressor 1 and a four-way valve 6. The outer face of a welded portion between a recess and protrusion part of the flexible tube 9 and the refrigerant pipe is covered with a rubber, which has an inner face having recesses and protrusions corresponding to the recess and protrusion part of the flexible tube and a cylindrical outer face, without leaving any gap.



LEGAL STATUS

[Date of request for examination]	12.09.1997
[Date of sending the examiner's decision of rejection]	15.08.2000
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	

[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] Refrigerant piping for air conditioners for which the external surface of the concave heights of the flexible tube made from stainless steel formed in the shape of bellows and a weld zone with refrigerant piping considers that the rubber which has the concave heights inside and cylindrical shape external surface corresponding to the above-mentioned concave heights covers without a clearance as the description in refrigerant piping for air conditioners for which the flexible tube was connected to the serial in the middle of refrigerant piping connected between the compressor and the heat exchanger.
[Claim 2] Refrigerant piping for air conditioners according to claim 1 characterized by attaching in the concave heights outside of the above-mentioned flexible tube the division object in alignment with the longitudinal direction of the pipe made of nitrile rubber which has a concave heights inside corresponding to the concave heights external surface of a flexible tube.
[Claim 3] Refrigerant piping for air conditioners according to claim 1 characterized by for packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made of nitrile rubber which set spacing to the method of the outside, and was arranged in the said alignment, and was formed in it existing without a clearance, and being stuck to it.
[Claim 4] Refrigerant piping for air conditioners according to claim 3 characterized by the degree of hardness of the nitrile rubber which constitutes a pipe being higher than the degree of hardness of polyurethane rubber.
[Claim 5] Refrigerant piping for air conditioners according to claim 1 characterized by for packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made from a vinyl chloride arranged in the said alignment by the method of the outside, and was formed in it existing without a clearance, and being stuck to it.
[Claim 6] Refrigerant piping for air conditioners according to claim 3 characterized by reinforcing the inside of the pipe made of nitrile rubber with the mesh made of rubber.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to refrigerant piping used for an air conditioner.
[0002]
[Description of the Prior Art] In order to prevent that vibration of a compressor generally transmits to each heat exchanger at the inhalation piping section of a communication trunk with the compressor of an air conditioner, indoor heat exchanger, and an outdoor heat exchanger, i.e., a compressor, and the regurgitation piping section from a compressor, the oscillating absorption section is prepared.
[0003] Drawing 10 is the perspective view showing the piping structure about the first conventional example. In drawing, piping consists of bare tubes made from elasticity phosphorus deoxidized copper, and oscillating absorption is performed by much loop-formation-like piping. A compressor (1) is elastically supported by an air-conditioner body or the base of an air conditioner through a vibroisolating material (2), and the four way valve (3) is arranged in the upper part. An accumulator (5) is connected in the middle of inhalation piping (4) which ties this four way valve (3) and compressor (1), and the above-mentioned four way valve (3) and the compressor (1) are connected by regurgitation piping (6). Furthermore, the four way valve (3) and the heat exchanger which is not illustrated are connected by the suction pipe (7) and the discharge tube (8). Each of each of these tubing is bent in the shape of a loop formation around the compressor (1).
[0004] Next, actuation is explained. Although a compressor (1) is made to drive, this vibration is spread through inhalation piping (4) and regurgitation piping (6) since vibration will occur from a compressor (1), if a refrigerant is made to compress and breathe out, and a heat exchanger is reached through a four way valve (3) Since each refrigerant piping has bent in the shape of a loop formation around a compressor (1), a vibrationproofing operation is performed and vibration is decreased gradually.
[0005] However, with such conventional piping structure, the loop formation formed in piping increases, the die length of piping becomes long, the flow resistance of a refrigerant not only increases, but a piping tooth space becomes large and there is a problem that equipment is enlarged.
[0006] Moreover, the number of the resonant frequencies of the pipe line also becomes large, it will be in the resonance state the operating speed of a compressor and whose resonant frequency of the pipe line corresponded depending on the operating speed of a compressor, and vibration becomes large, and in being the worst, breakage of piping takes place, as the loop formation formed in piping increases. If there are many loop formations formed in piping when control to which especially the frequency of the input power of a compressor is changed, and the operating speed of a compressor is changed is carried out, the resonating frequency will also increase and the design of the piping configuration for avoiding it and control of a compressor will become very difficult.
[0007] In order to solve such a problem, the air conditioner as shown in JP,61-54163,U as second conventional example is proposed. Drawing 11 is the perspective view showing the piping structure about this second conventional example. In drawing, the four way valve (3) is arranged above the compressor (1) which constitutes the unit of an air conditioner. An accumulator (5) is connected in the middle of inhalation piping (4) which ties this four way valve (3) and compressor (1), and the above-mentioned four way valve (3) and the compressor (1) are connected by regurgitation piping (6). The flexible tube (9) is infixed in the suction pipe (7) and discharge tube

(8) which furthermore connect the above-mentioned four way valve (3) and the heat exchanger which is not illustrated. As shown in drawing 12 , the flexible tube (9) was fabricated with elastic phosphorus-deoxidized-copper tubing, the spiral-like slot (10) was formed in that periphery section in the shape of bellows along with the longitudinal direction of forging, and as shown in drawing 13 , the spiral-like coil spring (11) has fitted loosely into the slot (10) of the shape of this spiral. This coil spring (11) is constituted so that the bending thru/or deformation to the direction of a path by tubing internal pressure may be regulated and the endurance of a flexible tube may be raised as much as possible, while it is fabricated with a rigid high ingredient and permits bending of the shaft orientations of a flexible tube (9) thru/or a longitudinal direction rather than elasticity phosphorus-deoxidized-copper tubing which forms a flexible tube (9). Therefore, while that bore is slightly formed greatly rather than the root diameter of a flexible tube, as for this coil spring (11), it is formed identically to the pitch of a spiral-like slot (10) by that pitch. Moreover, a flexible tube (9) has predetermined die length in the middle of a suction pipe (7) and a discharge tube (8), and is infixed in it, and connection with each refrigerant piping is made by welding etc.

[0008] Next, actuation is explained. The refrigerant compressed by the compressor (1) is breathed out and transported to regurgitation piping (6) connected to this. Although vibration of the compressor (1) generated in case a refrigerant is compressed and the regurgitation is carried out to regurgitation piping will reach a four way valve (3) through regurgitation piping (6) and inhalation piping (4) and will be further spread to a discharge tube (8) and a suction pipe (7), since the flexible tube (9) is infixed in the discharge tube (8) and the suction pipe (7) like the above, thereby, vibration is absorbed. Therefore, the vibration from a compressor (1) being absorbed with a flexible tube (9), and being spread to an outdoor heat exchanger is prevented. Since a flexible tube (9) is formed with elasticity phosphorus-deoxidized-copper tubing and the spiral-like slot (10) is established in the periphery section in accordance with shaft orientations, the elasticity to shaft orientations is acquired. Moreover, without deforming with the refrigerant which flows in a flexible tube (9), since the coil spring (11) fitted in loosely in the slot (10), and the telescopic motion to the shaft orientations was permitted and radial deformation is regulated, pressure resistance and fatigue strength are increased and endurance can be improved.

[0009] Moreover, there is refrigerant piping structure as shown in JP,63-75453,A as third conventional example. This arranges a wire gauze in the periphery of the flexible tube which consists of metal bellows, and covers the outside with the rubber barrel which carried out the thinning of the center section further. The curve posture of the metal accordion tube by vibration added from a compressor tends to be controlled by this, and it is going to attain reinforcement.

[0010]

[Problem(s) to be Solved by the Invention] Since the flexible tube of an air conditioner as shown in JP,61-54163,U as said second conventional example is made of elasticity phosphorus-deoxidized-copper tubing, even if it is reinforced with the coil spring, using it by the air conditioner runs short of reinforcement, work hardening occurs in aging by vibration, and it becomes impossible however, to acquire sufficient flexibility. Moreover, when a pressure is put on a flexible tube, it deforms into shaft orientations rather than radial for reinforcement by the coil spring. Therefore, the deformation over internal pressure becomes large. Moreover, in the above-mentioned conventional example, although the direction of bending of vibration of piping of an air conditioner was originally larger than shaft orientations, since sufficient measures to bending vibration were not taken, it had the problem that stress increase of a flexible tube and destruction took place.

[0011] moreover, with refrigerant piping structure as shown in JP,63-75453,A as said third conventional example Since clearance space exists between the concave heights of a flexible tube, and a rubber barrel, the deformation force, such as bending, at the time of ********** Since stress concentrated on the trough of bellows, or Yamabe locally, and there was a trouble that distribution of stress is fully hard to be performed, and the thinning of the center section of the rubber barrel was carried out extremely and it became easy to fracture when a crack goes into a center section by a certain cause, it was not able to be said as perfectness in respect of

dependability.
[0012] This invention was made in order to cancel the above troubles, and it fully absorbs vibration of refrigerant piping connected to the compressor of an air conditioner, and it has sufficient reinforcement to pressure resistance and bending stress, and aims at offering possible refrigerant piping for air conditioners of a miniaturization by low cost.
[0013]
[Means for Solving the Problem] Refrigerant piping for air conditioners concerning invention of claim 1 In refrigerant piping for air conditioners for which the flexible tube was connected to the serial in the middle of refrigerant piping connected with the compressor between heat exchangers The external surface of the concave heights of the flexible tube made from stainless steel formed in the shape of bellows and a weld zone with refrigerant piping is covered without the clearance by the rubber which has the concave heights inside and cylindrical shape external surface corresponding to the above-mentioned concave heights.
[0014] The division object with which refrigerant piping for air conditioners concerning invention of claim 2 met the longitudinal direction of the pipe made of nitrile rubber which has a concave heights inside corresponding to the concave heights external surface of a flexible tube in invention according to claim 1 is attached in the concave heights outside of the above-mentioned flexible tube.
[0015] In invention according to claim 1, refrigerant piping for air conditioners concerning invention of claim 3 exists without a clearance, and is stuck to packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made of nitrile rubber which set spacing to the method of the outside, and was arranged in the said alignment, and was formed in it.
[0016] Refrigerant piping for air conditioners concerning invention of claim 4 has the degree of hardness of the nitrile rubber which constitutes a pipe higher than the degree of hardness of polyurethane rubber in invention according to claim 3.
[0017] In invention according to claim 1, refrigerant piping for air conditioners concerning invention of claim 5 exists without a clearance, and is stuck to packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made from a vinyl chloride arranged in the said alignment by the method of the outside, and was formed in it.
[0018] Refrigerant piping for air conditioners concerning invention of claim 6 is reinforced with the mesh of the product [inside / of the pipe made of nitrile rubber] made of rubber in invention according to claim 3.
[0019]
[Function] In refrigerant piping for air conditioners by which the flexible tube was connected to the serial in the middle of refrigerant piping by which refrigerant piping for air conditioners in this invention was connected with the compressor between heat exchangers When the rubber which has the concave heights inside and cylindrical shape external surface corresponding to the above-mentioned concave heights covers without the clearance, the external surface of the concave heights of the flexible tube made from stainless steel formed in the shape of bellows and a weld zone with refrigerant piping It has the flexibility over the direction of bending, and the elongation of the shaft orientations of the flexible tube made from stainless steel can be regulated with the rigidity of rubber. Therefore, vibration by the compressor is absorbed by the flexibility over the direction of bending, with the pressure resistance over fluid pressure held. Moreover, since the stress of a flexible tube is distributed by rubber when the external surface of the concave heights of a flexible tube is covered by rubber without the clearance, stress concentration stops being able to happen easily and the rate of periodic damping increases by the internal damping of rubber. Moreover, when the external surface of the connection of a flexible tube and refrigerant piping is covered by rubber, it is intercepted with the open air and is hard coming to generate corrosion etc. in a weld zone.
[0020] Moreover, the almost same operation as the above is acquired by attaching in the

concave heights outside of the above-mentioned flexible tube the division object in alignment with the longitudinal direction of the pipe made of nitrile rubber which has a concave heights inside corresponding to the concave heights external surface of a flexible tube.
[0021] Moreover, by packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made of nitrile rubber which set spacing to the method of the outside, and was arranged in the said alignment, and was formed in it existing without a clearance, and being stuck to it In the direction of bending, the elongation of shaft orientations is regulated by the rigidity of the expanding direction of the pipe made of nitrile rubber, and the rigidity of the elongation of polyurethane rubber to the elongation of a flexible tube, without hardly losing flexibility. Therefore, vibration of a compressor is absorbed by the flexibility of the direction of bending, with pressure resistance maintained. Moreover, since packing of polyurethane rubber exists in the concave heights outside of a flexible tube without a clearance and the stress of a flexible tube is distributed by polyurethane rubber, stress concentration cannot happen easily and the rate of periodic damping increases by the internal damping of polyurethane rubber.
[0022] Furthermore, even if it is rigidity with packing of the polyurethane rubber which exists in the concave heights outside of a flexible tube without a clearance about the elongation of shaft orientations inadequate for regulating the elongation of shaft orientations, elongation is controllable [about the flexibility of bending, it is securable with the elasticity of polyurethane rubber by making higher than the degree of hardness of polyurethane rubber the degree of hardness of the nitrile rubber which constitutes a pipe, and] with the pipe made of outside nitrile rubber. Therefore, vibration of a compressor is absorbed by the flexibility of the direction of bending, with pressure resistance maintained. Moreover, since polyurethane rubber exists in the concave heights outside of a flexible tube without a clearance, stress concentration cannot happen easily and the rate of periodic damping also increases by the internal damping of polyurethane rubber.
[0023] Moreover, by packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to the clearance space of a flexible tube and the pipe made from a vinyl chloride arranged in the said alignment by the method of the outside, and was formed in it existing without a clearance, and being stuck to it The flexibility of bending is secured with the elasticity of polyurethane rubber, and is related with the elongation of shaft orientations. Since it is regulated with the pipe made from a vinyl chloride even if it is rigidity with the polyurethane rubber inadequate for regulating the elongation of shaft orientations with which the concave heights outside of a flexible tube was filled up, vibration produced with a compressor is absorbed by the flexibility of the direction of bending, with pressure resistance maintained. Moreover, since the concave heights outside of a flexible tube is filled up with polyurethane rubber and the stress of a flexible tube is distributed by polyurethane rubber, stress concentration stops being able to happen easily and the rate of periodic damping also increases by the internal damping of polyurethane rubber.
[0024] Moreover, the pipe made of nitrile rubber with which the inside was reinforced with the mesh made of rubber, set spacing to the way outside the flexible tube, and was arranged in the said alignment, By packing of the polyurethane rubber which was made to carry out impregnation hardening of the raw material which makes liquefied polyurethane rubber a subject to clearance space with a flexible tube, and was formed in it existing without a clearance, and being stuck to it The flexibility of bending is fully secured with the elasticity of polyurethane rubber, and is related with the elongation of shaft orientations. Even if it is rigidity with the polyurethane rubber inadequate for regulating the elongation of shaft orientations with which the concave heights outside of a flexible tube was filled up, it will regulate with the pipe made of nitrile rubber reinforced with the mesh made of rubber. Therefore, pressure resistance is maintained and vibration produced with a compressor is absorbed by the flexibility of the direction of bending. Moreover, since the concave heights outside of a flexible tube is filled up with polyurethane rubber and the stress of a flexible tube is distributed by polyurethane rubber, stress

concentration stops being able to happen easily and the rate of periodic damping also increases by the internal damping of polyurethane rubber.

[0025]

[Example]

Example 1. drawing 1 illustrates refrigerant piping of the compressor circumference of the outdoor unit of an air conditioner. A compressor (1) is elastically supported by an air-conditioner body or the base of an air conditioner through a vibroisolating material (2), and the four way valve (3) is arranged in the slanting upper part. An accumulator (5) is connected in the middle of inhalation piping (4) which ties this four way valve (3) and compressor (1), and the four way valve (3) and the compressor (1) are connected by regurgitation piping (6). Furthermore, the four way valve (3) and the heat exchanger which is not illustrated are connected by the suction pipe (7) and the discharge tube (8). (9) is a flexible tube and it is connected in serial in the middle of inhalation piping (4) which connects a four way valve (3) to an accumulator (5). Drawing 2 is the enlarged drawing showing the cross section of a flexible tube (9). A flexible tube (9) is bellows tubing made from stainless steel, and is welded to inhalation piping (4) as refrigerant piping by the weld zone (10) so that it may illustrate. The outside of bellows-like concave heights and a weld zone (10) is filled up with rubber (11), it sticks to it, and flattening of the outside is carried out like a cylindrical shape.

[0026] Next, actuation is explained. In drawing 1 , the vibration from a compressor (1) reaches propagation and a flexible tube (9) in inhalation piping (4) as an accumulator (5) and refrigerant piping. However, the vibration becomes quite small compared with vibration generated in the compressor (1). Therefore, vibration of the exterior unit of an air conditioner will be reduced more sharply than the exterior unit which is not using the flexible tube like drawing 9 . Moreover, although the elongation of shaft orientations arises when a flexible tube (9) is filled up with a refrigerant, stress concentration happens according to deformation only with a stainless flexible tube, and it distributes, without stress concentrating on a specific part by the rubber (11) which exists that there is no clearance in the concave heights outside of a flexible tube, although **** deformation or destruction arises, and the elongation of a flexible tube can be regulated. About deformation of the direction of bending, sufficient flexibility required for oscillating absorption is acquired by the above-mentioned rubber (11). Therefore, vibration of a compressor is absorbed by the flexibility of the direction of bending, with pressure resistance maintained. Moreover, the periodic-damping ratio at the time of vibration also goes up by the internal damping of rubber (11), and the effectiveness same with having attached the periodic-damping machine in the flexible tube is acquired. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, the miniaturization of a unit is attained. Moreover, since the weld zone (10) is covered with rubber (11), a weld zone can be intercepted from the matter which shortens the life of the moisture and others of the open air, and corrosion etc. can be prevented. In this example, although the flexible tube is used for inhalation piping, a flexible tube may be connected to both regurgitation piping or regurgitation piping, and inhalation piping at a serial.

[0027] The side elevation in which example 2. drawing 4 shows the outline of the flexible tube of this example, and drawing 3 are isomerism solution side elevations. As shown in drawing 3 , the 2-minute segmenter (11a) in alignment with the longitudinal direction of the pipe made of nitrile rubber which has a concave heights inside corresponding to the above-mentioned concave heights is attached in the concave heights outside of the above-mentioned flexible tube (9), and it sticks to the external surface of a weld zone (10) with inhalation piping (4) as bellows-like the concave heights outside and refrigerant piping of a flexible tube (9) made from stainless steel without a clearance.

[0028] Next, actuation is explained. When a flexible tube (9) is filled up with a refrigerant and internal pressure is applied, it distributes without suppressing the elongation of the shaft orientations of a flexible tube (9) by nitrile rubber (11), and the stress of a flexible tube (9) concentrating on a specific part, and the pressure resistance of a flexible tube (9) can be raised. Moreover, rubber can distribute, and the stress by vibration can also avoid the stress concentration by vibration, and can prevent a destructive operation beforehand. Moreover, a

flexible tube (9) will be reinforced by using nitrile rubber (11), without losing flexibility required for oscillating absorption. Furthermore, the periodic-damping ratio at the time of vibration also goes up by the internal damping of nitrile rubber (11), and there is effectiveness same with having attached the periodic-damping machine in the flexible tube. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping is small and ends, the miniaturization of a unit is attained. In this example, although nitrile rubber is used, even if it uses a styrene rubber, polyurethane rubber, chloroprene rubber, isobutylene isoprene rubber, ethylene-propylene rubber, or silicone rubber, the same effectiveness can be acquired. Moreover, a trichotomy object or a quadrisection object is sufficient as a division object.

[0029] The sectional side elevation in which example 3. drawing 6 shows the outline of the flexible tube of this example, and drawing 5 are the explanatory views showing the manufacture process of this flexible tube. As shown in drawing 5 , to the flexible tube made from stainless steel (9) welded to inhalation piping (4) as refrigerant piping The larger pipe made of nitrile rubber (12) than the outer diameter of a flexible tube (9) is beforehand arranged in the said alignment. If the clearance space of a flexible tube (9) and the pipe made of nitrile rubber (12) is made to pour in and harden the raw material which mixed the chain elongation agent and the cross linking agent to liquefied polyurethane rubber (11) As shown in drawing 6 , that to which packing of polyurethane rubber exists in the clearance space of the pipe made of nitrile rubber (12) and a flexible tube (9) without a clearance is obtained.

[0030] Next, actuation is explained. When a flexible tube (9) is filled up with a refrigerant and internal pressure is added, it distributes without suppressing the elongation of a flexible tube (9) by the pipe (12) and polyurethane rubber (11) made of nitrile rubber, and the stress of a flexible tube (9) concentrating on a particular part, and pressure-proofing of a flexible tube can be raised. Furthermore, it is distributed by the pipe (12) made of polyurethane rubber (11) and nitrile rubber, and the stress by vibration can also prevent the stress concentration by vibration, and destruction. Moreover, a flexible tube (9) can be reinforced, without losing flexibility required for oscillating absorption by using the pipe (12) made of polyurethane rubber (11) and nitrile rubber. By the internal damping of the pipe (12) of further the product made of polyurethane rubber (11) and nitrile rubber, the periodic-damping ratio at the time of vibration also goes up, and the effectiveness same with having attached the periodic-damping machine in the flexible tube is acquired. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping is small and ends, the miniaturization of a unit is attained. Moreover, since it can manufacture using a terminal seal member, without needing big metal mold since packing of polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension in this example, the flexible tube of the low cost excellent in pressure-proofing and oscillating absorptivity can be obtained. In this example, although polyurethane rubber and nitrile rubber are used, even if it transposes to a styrene rubber, chloroprene rubber, isobutylene isoprene rubber, ethylene-propylene rubber, or silicone rubber, the same effectiveness can be acquired.

[0031] Moreover, although packing of polyurethane rubber is formed in clearance space with the pipe made of nitrile rubber which set spacing to the flexible tube and the method of that outside, and was arranged in the said alignment in the above-mentioned example, this example set up more firmly than the degree of hardness of polyurethane rubber (11) the degree of hardness of the pipe made of nitrile rubber (12) especially. Usually, a rubber degree of hardness is chosen in 50 - 80 degrees. Thereby, the deformation at the time of the pressure load of a flexible tube can be regulated in the pipe made of nitrile rubber (12), and pressure resistance can be raised. Moreover, oscillating absorptivity can be improved by the polyurethane rubber (11) by which impregnation hardening was carried out inside. Furthermore, it can be used on broad conditions by choosing suitably the ratio of the degree of hardness of the polyurethane rubber (11) poured into the pipe (12) and the interior made of nitrile rubber according to a service condition. In this example, although nitrile rubber is used as a material of a pipe, even if it transposes to a styrene rubber, polyurethane rubber, chloroprene rubber, isobutylene isoprene rubber, ethylene-propylene rubber, or silicone rubber, the same effectiveness can be acquired.

[0032] Example 5. drawing 7 is the sectional side elevation showing the outline of the flexible tube of this example. As shown in drawing, to the flexible tube made from stainless steel (9) welded to the suction pipe (4) as refrigerant piping The larger pipe made from a vinyl chloride (13) than the outer diameter of a flexible tube (9) is beforehand arranged in the said alignment. If impregnation hardening of the raw material which mixed the chain elongation agent and the cross linking agent with the flexible tube (9) to polyurethane rubber (11) liquefied to the clearance space of the pipe made from a vinyl chloride (13) is carried out That to which packing of polyurethane rubber exists in the clearance space of the pipe made from a vinyl chloride (13) and a flexible tube (9) without a clearance is obtained.
[0033] Next, actuation is explained. When a flexible tube (9) is filled up with a refrigerant and internal pressure is applied, the elongation of a flexible tube (9) is controlled with the pipe (13) made from polyurethane rubber (11) and a vinyl chloride. Moreover, the stress of the particular part of a flexible tube (9) does not concentrate by polyurethane rubber (11), but it distributes and the pressure resistance of a flexible tube (9) can be improved. Moreover, the stress by vibration is also distributed by polyurethane rubber (11), and the stress concentration by vibration and destruction can be prevented. Moreover, a flexible tube (9) can be reinforced by use of polyurethane rubber (11), without losing flexibility required for periodic damping. Furthermore, by the internal damping of polyurethane rubber (11), the damping ratio at the time of vibration also goes up, and the effectiveness same with having attached the periodic-damping machine in the flexible tube can be attained. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, the miniaturization of a unit is attained. Moreover, since it can manufacture using a terminal seal member, without needing big metal mold since packing of polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension also in this example, the flexible tube of the low cost excellent in proof-pressure oscillating absorptivity can be obtained. In this example, although nitrile rubber is used, even if it transposes to a styrene rubber, polyurethane rubber, chloroprene rubber, isobutylene isoprene rubber, ethylene-propylene rubber, or silicone rubber, the same effectiveness can be acquired.
[0034] Example 6. drawing 8 is the sectional side elevation showing the outline of the flexible tube of this example. As shown in drawing 8 , to the flexible tube made from stainless steel (9) welded to the suction pipe (4) as refrigerant piping The pipe made of nitrile rubber (12) reinforced with the mesh (14) of the product [it is larger than the outer diameter of a flexible tube (9), and / inside] made of rubber is beforehand arranged in the said alignment. If the clearance space of a flexible tube (9) and the pipe made of nitrile rubber (12) is made to pour in and harden the raw material which mixed the chain elongation agent and the cross linking agent to liquefied polyurethane rubber (11) That to which packing of polyurethane rubber exists in the clearance space of the pipe made of nitrile rubber (12) and a flexible tube (9) without a clearance is obtained.
[0035] Next, actuation is explained. When a flexible tube (9) is filled up with a refrigerant and internal pressure is added, it distributes without being stopped with the pipe made of nitrile rubber (12) with which the elongation of a flexible tube (9) was reinforced with the mesh made of rubber (14), and stress concentrating on the particular part of a flexible tube, and the pressure resistance of a flexible tube can be improved. Moreover, since the pipe made of nitrile rubber (12) is reinforced with the mesh made of rubber (14), still higher pressure resistance can be acquired rather than the thing of the structure which combined the pipe and polyurethane rubber made of nitrile rubber of an example 3 and an example 4. Moreover, polyurethane rubber (11) distributes and the stress by vibration can also prevent the stress concentration by vibration, and destruction. Furthermore, the periodic-damping ratio at the time of vibration also goes up by the internal damping of polyurethane rubber (11), and the effectiveness same with having attached the periodic-damping machine in the flexible tube is acquired. Therefore, since the tooth space which the die length of refrigerant piping can be shortened and moreover arranges refrigerant piping is small and ends, the miniaturization of a unit is possible. Moreover, since it can manufacture using a terminal seal member, without needing big metal mold since packing of

polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension in this example, the flexible tube of the low cost excellent in pressure-proofing and oscillating absorptivity can be obtained. In this example, although nitrile rubber is used, even if it transposes to a styrene rubber, polyurethane rubber, chloroprene rubber, isobutylene isoprene rubber, ethylene-propylene rubber, or silicone rubber, the same effectiveness can be acquired.

[0036]

[Effect of the Invention] Since this invention is constituted as explained above, it does effectiveness as taken below so.

[0037] In refrigerant piping for air conditioners to which the flexible tube made from stainless steel was connected in the middle of refrigerant piping connected between the compressor and the heat exchanger at the serial According to the configuration covered without the clearance by the rubber which has the concave heights inside and cylindrical shape external surface corresponding to the above-mentioned concave heights, the external surface of the concave heights of the flexible tube made from stainless steel formed in the shape of bellows and a weld zone with refrigerant piping A flexible tube can be reinforced without losing flexibility and the reinforcement and oscillating absorptivity over proof-pressure bending stress can be improved. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, it has the effectiveness whose miniaturization of a unit is attained. Moreover, when the external surface of the connection of a flexible tube and refrigerant piping is covered by rubber, it is hard coming to generate corrosion etc. in a weld zone.

[0038] Moreover, according to the configuration in which the division object in alignment with the longitudinal direction of the pipe made of nitrile rubber which has a concave heights inside corresponding to the concave heights external surface of the flexible tube made from stainless steel formed in the shape of bellows is attached in the concave heights outside of the above-mentioned flexible tube, a flexible tube can be reinforced without losing flexibility and the reinforcement and oscillating absorptivity over pressure resistance and bending stress can be improved. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, it has the effectiveness whose miniaturization of a unit is attained. Furthermore, since productivity is high and an attachment activity is also easy productivity, the division object in alignment with the longitudinal direction of the pipe made of nitrile rubber which has the above-mentioned concave heights inside is effective in reducing a manufacturing cost.

[0039] Moreover, a flexible tube reinforces without losing flexibility and, according to the configuration for which packing of the polyurethane rubber formed by carrying out impregnation hardening exists without a clearance to the clearance space of the flexible tube made from stainless steel formed in the shape of bellows, and the pipe made of nitrile rubber which set spacing to the method of the outside, and was arranged in the said alignment, and the raw material which makes liquefied polyurethane rubber a subject is stuck to it in it, pressure resistance, the strength property over bending stress, and oscillating absorptivity become good. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, the miniaturization of a unit is attained. Furthermore, since packing of polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension, productivity can be raised and the flexible tube excellent in pressure-resistant oscillating absorptivity can be obtained by low cost.

[0040] Moreover, by changing the degree of hardness of the polyurethane rubber poured into the pipe and the interior made of nitrile rubber, and making harder than polyurethane rubber the degree of hardness of the nitrile rubber which constitutes a pipe, a flexible tube is reinforced without losing flexibility and pressure resistance, the strength property over bending stress, and oscillating absorptivity improve. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, the miniaturization of a unit is attained. Moreover, there is effectiveness which raises productivity

and can be manufactured by low cost.
[0041] Moreover, a flexible tube reinforces without losing flexibility and, according to the configuration for which packing of the polyurethane rubber formed by carrying out impregnation hardening exists without a clearance to the clearance space of the flexible tube made from stainless steel formed in the shape of bellows, and the pipe made from a vinyl chloride which set spacing to the method of the outside, and was arranged in the said alignment, and the raw material which makes liquefied polyurethane rubber a subject is stuck to it in it, pressure resistance, the strength property over bending stress, and oscillating absorptivity become good. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, it has the effectiveness whose miniaturization of a unit is attained. Moreover, since packing of polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension, productivity can be raised and the flexible tube excellent in pressure resistance and oscillating absorptivity can be obtained by low cost.
[0042] Moreover, the pipe made of nitrile rubber with which the inside was reinforced with the mesh made of rubber, set spacing to the way outside the flexible tube of the shape of bellows made from stainless steel, and was arranged in the said alignment, According to the configuration for which packing of the polyurethane rubber formed by carrying out impregnation hardening exists without a clearance to clearance space with the above-mentioned flexible tube, and the raw material which makes liquefied polyurethane rubber a subject is stuck to it in it A flexible tube can be reinforced without losing flexibility and pressure resistance, the strength property over bending stress, and oscillating absorptivity can be improved. Therefore, the die length of refrigerant piping can be shortened, and since the tooth space which moreover arranges refrigerant piping can be made small, it has the effectiveness whose miniaturization of a unit is attained. Furthermore, since packing of polyurethane rubber can be obtained by impregnation of liquefied polyurethane rubber according to the configuration of a flexible tube, and a dimension, productivity can be raised and the flexible tube excellent in pressure-resistant oscillating absorptivity can be obtained by low cost.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The whole outline perspective view showing the example 1 of this invention.
[Drawing 2] The sectional side elevation showing the flexible tube of the example 1 of this invention.
[Drawing 3] The decomposition side elevation of the flexible tube of the example 2 of this invention.
[Drawing 4] The side elevation of the flexible tube of the example 2 of this invention.
[Drawing 5] The explanatory view about manufacture of the flexible tube of the example 3 of this invention.

[Drawing 6] The sectional side elevation of the flexible tube of the example 3 of this invention, or an example 4.
[Drawing 7] The sectional side elevation of the flexible tube of the example 5 of this invention.
[Drawing 8] The sectional side elevation of the flexible tube of the example 6 of this invention.
[Drawing 9] The related Fig. of the frequency and vibration level of the flexible-tube existence of the example 1 of this invention.
[Drawing 10] The perspective view showing the piping structure about the first conventional example.
[Drawing 11] The perspective view showing the piping structure about the second conventional example.
[Drawing 12] The side elevation showing the flexible tube of drawing 11 .
[Drawing 13] The sectional side elevation showing the flexible tube of drawing 11 .
[Description of Notations]
1 A compressor, the pipe made of 2 nitrile rubber, the pipe made from 13 vinyl chloride, mesh made of 14 rubber. A vibroisolating material, 3 A four way valve, 4 Inhalation piping as refrigerant piping, five accumulators, 6 Regurgitation piping as refrigerant piping, 7 The suction pipe as refrigerant piping, 8 The discharge tube as refrigerant piping, 9 A flexible tube, 10 A weld zone, 11 Polyurethane rubber, 11a The division object of polyurethane rubber, 12

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（A）**　(11)特許出願公開番号

特開平8－14705

(43)公開日　平成８年(1996)１月19日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｆ２５Ｂ　41/00	Ｇ			
Ｆ２４Ｆ　5/00	Ｎ			

審査請求　未請求　請求項の数６　ＯＬ　（全 ９ 頁）

(21)出願番号　特願平6－143529

(22)出願日　平成６年(1994)６月24日

(71)出願人　000006013
三菱電機株式会社
東京都千代田区丸の内二丁目２番３号

(72)発明者　望月　厚志
静岡市小鹿三丁目18番１号　三菱電機エンジニアリング株式会社名古屋事業所静岡支所内

(72)発明者　永野　雅夫
静岡市小鹿三丁目18番１号　三菱電機株式会社住環境エンジニアリング統括センター内

(74)代理人　弁理士　葛野　信一

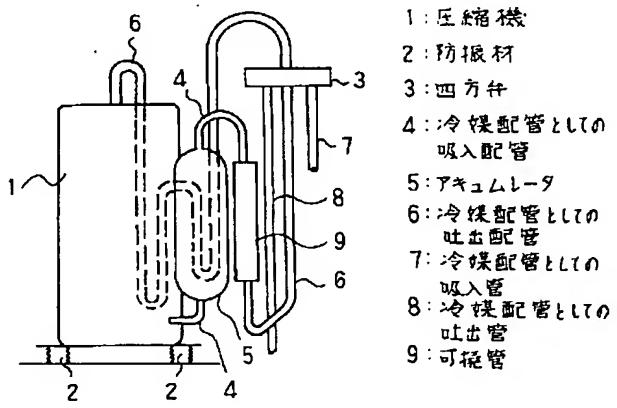
最終頁に続く

(54)【発明の名称】　空気調和機用冷媒配管

(57)【要約】

【目的】　空気調和機の圧縮機に接続される冷媒配管の振動を充分に吸収し、耐圧性、曲げ応力に対する充分な強度を有し、小型化の可能な空気調和機用冷媒配管を低コストで提供する。

【構成】　圧縮機(1)と、四方弁(6)との間に接続された冷媒配管の途中にベローズ状に形成されたステンレス製の可撓管(9)を直列に接続し、この可撓管(9)の凹凸部および冷媒配管との溶接部の外面を上記凹凸部に対応する凹凸部内面と円筒形外面とを有するゴム(10)により隙間なくカバーする。



1

【特許請求の範囲】

【請求項１】　圧縮機と熱交換器との間に接続された冷媒配管の途中に可撓管が直列に接続された空気調和機用冷媒配管において、ベローズ状に形成されたステンレス製の可撓管の凹凸部および冷媒配管との溶接部の外面が、上記凹凸部に対応する凹凸部内面と円筒形外面とを有するゴムにより隙間なくカバーされていることを特徴とする空気調和機用冷媒配管。

【請求項２】　可撓管の凹凸部外面に対応する凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った分割体が上記可撓管の凹凸部外側に嵌着されていることを特徴とする請求項１記載の空気調和機用冷媒配管。

【請求項３】　可撓管と、その外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されていることを特徴とする請求項１記載の空気調和機用冷媒配管。

【請求項４】　パイプを構成するニトリルゴムの硬度がウレタンゴムの硬度よりも高いことを特徴とする請求項３記載の空気調和機用冷媒配管。

【請求項５】　可撓管と、その外方に同心的に配設された塩化ビニル製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されていることを特徴とする請求項１記載の空気調和機用冷媒配管。

【請求項６】　ニトリルゴム製のパイプの内側がゴム製のメッシュで補強されていることを特徴とする請求項３記載の空気調和機用冷媒配管。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は空気調和機に使用される冷媒配管に関するものである。

【０００２】

【従来の技術】一般に空気調和機の圧縮機と室内熱交換器および室外熱交換器との接続管、すなわち圧縮機への吸入配管部および圧縮機よりの吐出配管部には圧縮器の振動が各熱交換器に伝達するのを防止するために振動吸収部が設けられている。

【０００３】図１０は第一の従来例に関する配管構造を示す斜視図である。図において、配管は軟質燐脱酸銅製の裸管で構成されており、多数のループ状配管によって振動吸収が行われるようになっている。圧縮機(1)は空気調和機本体あるいは空気調和機の基盤に防振材(2)を介して弾性的に支持され、その上方に四方弁(3)が配設されている。この四方弁(3)と圧縮機(1)を結ぶ吸入配管(4)の途中にはアキュムレータ(5)が接続され、上記四方弁(3)と圧縮機(1)とは吐出配管(6)により接続されている。さらに、四方弁(3)と図示されない熱交換器とが吸入管(7)および吐出管(8)により接続されている。これらの各管のそれぞれが圧縮機(1)の周囲でループ状に折曲されている。

2

【０００４】次に動作について説明する。圧縮機(1)を駆動させて、冷媒を圧縮して吐出させると、圧縮機(1)から振動が発生するため、この振動は、吸入配管(4)および吐出配管(6)を介して伝播され、四方弁(3)を経て熱交換器に到達するが、各冷媒配管が圧縮機(1)の周囲にループ状に折曲しているため、防振作用が行われ、振動は次第に減衰される。

【０００５】しかし、このような従来の配管構造では、配管に形成されるループが多くなり、配管の長さが長くなって冷媒の流動抵抗が増大するばかりでなく、配管スペースが大きくなり、装置が大型化するという問題がある。

【０００６】また、配管に形成されるループが多くなるに従って、配管系の固有振動数の数も大きくなり、圧縮機の運転速度によっては、圧縮機の運転速度と配管系の固有振動数が一致した共振状態となり、振動が大きくなり、最悪の場合には、配管の破損が起る。特に圧縮機の入力電源の周波数を変化させ、圧縮機の運転速度を変化させる制御をした場合、配管に形成されたループが多いと、共振する周波数も多くなり、それを避けるための配管形状の設計、圧縮機の制御が非常に困難となる。

【０００７】このような問題を解決するために第二の従来例として実開昭６１－５４１６３号公報に示すような空気調和機が提案されている。図１１はこの第二の従来例に関する配管構造を示す斜視図である。図において、空気調和機のユニットを構成する圧縮機(1)の上方には、四方弁(3)が配設されている。この四方弁(3)と圧縮機(1)を結ぶ吸入配管(4)の途中にはアキュムレータ(5)が接続され、上記四方弁(3)と圧縮機(1)とは吐出配管(6)により接続されている。さらに上記四方弁(3)と図示されない熱交換器とを結ぶ吸入管(7)および吐出管(8)には可撓管(9)が介装されている。図１２に示すように、可撓管(9)は軟質の燐脱酸銅管によって成形され、鍛造加工によりその外周部には長手方向に沿ってスパイラル状の溝(10)が蛇腹状に形成され、図１３に示す如くこのスパイラル状の溝(10)にはスパイラル状のコイルスプリング(11)が遊嵌されている。このコイルスプリング(11)は可撓管(9)を形成する軟質燐脱酸銅管よりも剛性の高い材料によって成形され、可撓管(9)の軸方向ないし長手方向の撓みを許容すると共に、管内圧による径方向への撓みないし変形を規制して可撓管の耐久性を可及的に高めるように構成されている。従って、このコイルスプリング(11)はその内径が可撓管の谷径よりもわずかに大きく形成されると共にそのピッチはスパイラル状の溝(10)のピッチと同一に形成されている。また、可撓管(9)は吸入管(7)および吐出管(8)の途中に所定の長さを有して介装され、各冷媒配管との接続は溶接等により行われている。

3

【０００８】次に動作について説明する。圧縮機(1)により圧縮された冷媒はこれに接続された吐出配管(6)に吐出されて移送される。冷媒を圧縮して吐出配管に吐出する際に発生する圧縮機(1)の振動は、吐出配管(6)および吸入配管(4)を介して四方弁(3)に達し、更に吐出管(8)および吸入管(7)に伝播されることになるが、上記の如く吐出管(8)および吸入管(7)には可撓管(9)が介装されているために、これにより振動が吸収される。従って、圧縮機(1)からの振動は可撓管(9)で吸収されて室外熱交換器に伝播されることが防止される。可撓管(9)は軟質燐脱酸銅管によって形成され、かつ軸方向に沿って外周部にスパイラル状の溝(10)が設けられているので、軸方向への伸縮性が得られる。また、溝(10)内にはコイルスプリング(11)が遊嵌され、その軸方向への伸縮を許容し、かつ半径方向への変形を規制しているために、可撓管(9)内に流れる冷媒によって変形されることなく、耐圧強度、疲労強度が増加されて耐久性を向上することができる。

【０００９】また、第三の従来例として、例えば特開昭６３－７５４５３号公報に示すような冷媒配管構造がある。これは、金属製蛇腹からなる可撓管の外周に金網を配設し、さらにその外側を中央部を薄肉化したゴム筒体で被覆したものである。これにより、圧縮機から加えられる振動による金属製蛇腹管の湾曲姿勢を制御し長寿命化を図ろうとするものである。

【００１０】

【発明が解決しようとする課題】しかしながら、前記第二の従来例として実開昭６１－５４１６３号公報に示すような空気調和機の可撓管は軟質燐脱酸銅管でできているため、コイルスプリングで補強されていても、空気調和機で使用するには強度が不足し、振動による経時変化で加工硬化が発生し、十分な可撓性を得ることができなくなる。また可撓管に圧力をかけた場合、コイルスプリングによる補強のため、半径方向よりも軸方向に変形する。従って内圧に対する変形が大きくなる。また、空気調和機の配管の振動は本来軸方向よりも曲げ方向の方が大きいにも拘らず、上記従来例では曲げ振動に対する充分な対策が施されていないため、可撓管の応力増大、破壊が起るという問題があった。

【００１１】また、前記第三の従来例として特開昭６３－７５４５３号公報に示すような冷媒配管構造では、可撓管の凹凸部とゴム筒体との間に隙間空間が存在するため、曲げなど変形力がはたらいたときに、蛇腹の谷部又は山部に局部的に応力が集中し、応力の分散が充分に行われ難いという問題点があり、また、ゴム筒体の中央部が極端に薄肉化されているため、中央部に何等かの原因で亀裂が入った時に破断し易くなるので、信頼性の面で万全とはいえなかった。

【００１２】この発明は上記のような問題点を解消するためになされたもので、空気調和機の圧縮機に接続される冷媒配管の振動を充分に吸収し、耐圧性、曲げ応力に対する充分な強度を有し、小型化の可能な空気調和機用冷媒配管を低コストで提供することを目的とする。

4

【００１３】

【課題を解決するための手段】請求項１の発明に係る空気調和機用冷媒配管は、圧縮機と、熱交換器との間に接続された冷媒配管の途中に可撓管が直列に接続された空気調和機用冷媒配管において、ベローズ状に形成されたステンレス製の可撓管の凹凸部および冷媒配管との溶接部の外面が、上記凹凸部に対応する凹凸部内面と円筒形外面とを有するゴムにより隙間なくカバーされているものである。

【００１４】請求項２の発明に係る空気調和機用冷媒配管は、請求項１記載の発明において、可撓管の凹凸部外面に対応する凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った分割体が上記可撓管の凹凸部外側に嵌着されているものである。

【００１５】請求項３の発明に係る空気調和機用冷媒配管は、請求項１記載の発明において、可撓管と、その外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプとの隙間空間へウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されているものである。

【００１６】請求項４の発明に係る空気調和機用冷媒配管は、請求項３記載の発明において、パイプを構成するニトリルゴムの硬度がウレタンゴムの硬度よりも高いものである。

【００１７】請求項５の発明に係る空気調和機用冷媒配管は、請求項１記載の発明において、可撓管と、その外方に同心的に配設された塩化ビニル製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されているものである。

【００１８】請求項６の発明に係る空気調和機用冷媒配管は、請求項３記載の発明において、ニトリルゴム製のパイプの内側がゴム製のメッシュで補強されているものである。

【００１９】

【作用】この発明における空気調和機用冷媒配管は、圧縮機と、熱交換器との間に接続された冷媒配管の途中に可撓管が直列に接続された空気調和機用冷媒配管において、ベローズ状に形成されたステンレス製の可撓管の凹凸部および冷媒配管との溶接部の外面が、上記凹凸部に対応する凹凸部内面と円筒形外面とを有するゴムにより隙間なくカバーされていることにより、曲げ方向に対する可撓性を有し、ゴムの剛性により、ステンレス製の可撓管の軸方向の伸びを規制することができる。そのため流体圧力に対する耐圧性を保持したまま曲げ方向に対する可撓性により、圧縮機による振動を吸収する。また、可撓管の凹凸部の外面がゴムにより隙間なくカバーされ

5

ていることにより、可撓管の応力がゴムにより分散されるため、応力集中が起りにくくなり、ゴムの内部減衰により振動減衰率が増加する。また、可撓管と冷媒配管との接続部の外面がゴムによりカバーされていることにより、外気と遮断され溶接部に腐食等が発生しにくくなる。

【００２０】また、可撓管の凹凸部外面に対応する凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った分割体が上記可撓管の凹凸部外側に嵌着されていることにより、上記とほぼ同様の作用が得られる。

【００２１】また、可撓管と、その外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されていることにより、曲げ方向には可撓性をほとんど失わずに、可撓管の伸びに対してニトリルゴム製のパイプの伸長方向の剛性とウレタンゴムの伸びの剛性により、軸方向の伸びが規制される。そのため耐圧性を維持したまま、曲げ方向の可撓性により圧縮機の振動を吸収する。また、可撓管の凹凸部外側にウレタンゴムの充填物が隙間なく存在するので、可撓管の応力がウレタンゴムにより分散されるため、応力集中が起りにくく、ウレタンゴムの内部減衰により振動減衰率が増加する。

【００２２】さらに、パイプを構成するニトリルゴムの硬度をウレタンゴムの硬度よりも高くすることにより、曲げの可撓性に関してはウレタンゴムの弾性により確保でき、軸方向の伸びに関しては、可撓管の凹凸部外側に隙間なく存在するウレタンゴムの充填物が軸方向の伸びを規制するのに不充分な剛性であっても、外側のニトリルゴム製のパイプにより伸びを規制できる。そのため耐圧性を維持したまま、曲げ方向の可撓性により圧縮機の振動を吸収する。また、可撓管の凹凸部外側にウレタンゴムが隙間なく存在するため、応力集中が起りにくく、ウレタンゴムの内部減衰により振動減衰率も増加する。

【００２３】また、可撓管と、その外方に同心的に配設された塩化ビニル製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されていることにより、曲げの可撓性はウレタンゴムの弾性により確保され、軸方向の伸びに関しては、可撓管の凹凸部外側に充填されたウレタンゴムが軸方向の伸びを規制するのに不充分な剛性であっても、塩化ビニル製のパイプにより規制されるので、耐圧性を維持したまま曲げ方向の可撓性により圧縮機により生ずる振動を吸収する。また、可撓管の凹凸部外側にウレタンゴムが充填されているので可撓管の応力がウレタンゴムにより分散されるため、応力集中が起りにくくなり、ウレタンゴムの内部減衰により振動減衰率も増加する。

【００２４】また、内側がゴム製のメッシュで補強され、可撓管の外方に間隔をおいて同心的に配設されたニ

6

トリルゴム製のパイプと、可撓管との隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化させて形成されたウレタンゴムの充填物が隙間なく存在し密着されていることにより、曲げの可撓性はウレタンゴムの弾性により充分に確保され、軸方向の伸びに関しては、可撓管の凹凸部外側に充填されたウレタンゴムが軸方向の伸びを規制するのに不充分な剛性であっても、ゴム製のメッシュで補強されたニトリルゴム製のパイプにより規制することになる。そのため耐圧性が維持され、曲げ方向の可撓性により圧縮機により生ずる振動を吸収する。また、可撓管の凹凸部外側にウレタンゴムが充填されているため、可撓管の応力がウレタンゴムにより分散されるので、応力集中が起りにくくなり、ウレタンゴムの内部減衰により振動減衰率も増加する。

【００２５】

【実施例】

実施例１．図１は空気調和機の室外ユニットの圧縮機周辺の冷媒配管を図示したものである。圧縮機(1)は空気調和機本体あるいは空気調和機の基盤に防振材(2)を介して弾性的に支持され、その斜め上方に四方弁(3)が配設されている。この四方弁(3)と圧縮機(1)を結ぶ吸入配管(4)の途中にはアキュムレータ(5)が接続され、四方弁(3)と圧縮機(1)とは吐出配管(6)により接続されている。さらに四方弁(3)と図示されない熱交換器とが吸入管(7)および吐出管(8)により接続されている。(9)は可撓管で、アキュムレータ(5)と四方弁(3)とを結ぶ吸入配管(4)の途中において直列的に接続されている。図２は可撓管(9)の断面を示す拡大図である。図示するように、可撓管(9)はステンレス製のベローズ管で、冷媒配管としての吸入配管(4)に溶接部(10)で溶接されている。蛇腹状の凹凸部および溶接部(10)の外側にはゴム(11)が充填され、密着し、その外側は円筒形のように平坦化されている。

【００２６】次に動作について説明する。図１において、圧縮機(1)からの振動はアキュムレータ(5)、冷媒配管としての吸入配管(4)を伝わり、可撓管(9)に達する。しかしその振動は圧縮機(1)に発生した振動に比べかなり小さくなる。従って空気調和機の室外機の振動は図９のように可撓管を使用していない室外機よりも大幅に低減されることになる。また、可撓管(9)に冷媒が充填されたとき、軸方向の伸びが生ずるが、ステンレスの可撓管のみでは変形により、応力集中が起り、朔性変形、あるいは破壊が生ずるが可撓管の凹凸部外側に隙間なく存在するゴム(11)により特定の部分に応力が集中することなく分散され、可撓管の伸びを規制することができる。曲げ方向の変形に関しては、上記ゴム(11)により振動吸収に必要な充分な可撓性が得られる。そのため耐圧性を維持したまま曲げ方向の可撓性により圧縮機の振動を吸収する。また、ゴム(11)の内部減衰により振動時の振動減衰比も上り、可撓管に振動減衰器を取付けたのと同様

の効果を得る。そのため、冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる。また溶接部(10)もゴム(11)でカバーされているため、外気の水分その他の寿命を短縮する物質から溶接部を遮断し、腐食等を防ぐことができる。本実施例では、吸入配管に可撓管を使用しているが、吐出配管又は吐出配管と吸入配管の両方に可撓管を直列に接続してもよい。

【００２７】実施例２．図４はこの実施例の可撓管の概略を示す側面図、図３は同分解側面図である。図３に示すように、ステンレス製のベローズ状の可撓管(9)の凹凸部外側および冷媒配管としての吸入配管(4)との溶接部(10)の外面に上記凹凸部に対応する凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った２分割体(11a)を上記可撓管(9)の凹凸部外側に嵌着し、隙間なく密着したものである。

【００２８】次に動作について説明する。可撓管(9)に冷媒が充填され、内圧が加えられた時に、可撓管(9)の軸方向の伸びがニトリルゴム(11)により抑えられ、また可撓管(9)の応力が特定の部分に集中せずに分散され、可撓管(9)の耐圧性を上げることができる。また、振動による応力もゴムによって分散され、振動による応力集中を回避し、破壊作用を未然に防止することができる。またニトリルゴム(11)を使用することにより、振動吸収に必要な可撓性を失うことなく可撓管(9)を補強することになる。さらにニトリルゴム(11)の内部減衰により振動時の振動減衰比もあがり、可撓管に振動減衰機を取付けたのと同様の効果がある。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースが小さくて済むので、ユニットの小型化が可能となる。本実施例では、ニトリルゴムを使用しているが、スチレンゴム、ウレタンゴム、クロロブレンゴム、ブチルゴム、エチレン・プロピレンゴム又はシリコンゴムを用いても同様の効果を得ることができる。また、分割体は３分割体又は４分割体でもよい。

【００２９】実施例３．図６はこの実施例の可撓管の概略を示す側断面図、図５はこの可撓管の製造過程を示す説明図である。図５に示すように、冷媒配管としての吸入配管(4)に溶接されたステンレス製の可撓管(9)に、予め可撓管(9)の外径よりも大きいニトリルゴム製のパイプ(12)を同心的に配設し、可撓管(9)とニトリルゴム製のパイプ(12)との隙間空間に液状のウレタンゴム(11)に鎖延長剤及び架橋剤を混合した原料を注入し硬化させると、図６に示す如く、ニトリルゴム製のパイプ(12)と可撓管(9)との隙間空間にウレタンゴムの充填物が隙間なく存在するものが得られる。

【００３０】次に動作について説明する。可撓管(9)に冷媒が充填され、内圧が加わった時に、可撓管(9)の伸びがニトリルゴム製のパイプ(12)及びウレタンゴム(11)により抑えられ、また、可撓管(9)の応力が特定部分に

集中せずに分散され、可撓管の耐圧を上げることができる。さらに、振動による応力もウレタンゴム(11)およびニトリルゴム製のパイプ(12)によって分散され、振動による応力集中、破壊を防ぐことができる。また、ウレタンゴム(11)及びニトリルゴム製のパイプ(12)を使用することにより、振動吸収に必要な可撓性を失うことなく、可撓管(9)を補強することができる。さらにウレタンゴム(11)およびニトリルゴム製のパイプ(12)の内部減衰により、振動時の振動減衰比も上り、可撓管に振動減衰機を取付けたのと同様の効果を得る。そのため冷媒配管の長さを短くでき、しかも冷媒配管を配設するスペースが小さくて済むため、ユニットの小型化が可能となる。また、この実施例では可撓管の形状、寸法に合わせて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので大きな金型を必要とすることなく、端末シール部材を用いて製造できるので、耐圧、振動吸収性にすぐれた低コストの可撓管を得ることができる。本実施例では、ウレタンゴム、ニトリルゴムを使用しているが、スチレンゴム、クロロブレンゴム、ブチルゴム、エチレン・プロピレンゴム又はシリコンゴムに置き換えても同様の効果を得ることができる。

【００３１】また、上記実施例では、可撓管とその外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプとの隙間空間にウレタンゴムの充填物を形成してあるが、特にニトリルゴム製のパイプ(12)の硬度をウレタンゴム(11)の硬度よりも硬く設定したのがこの実施例である。通常ゴム硬度は５０～８０度の範囲で選択される。これにより、ニトリルゴム製のパイプ(12)で可撓管の圧力負荷時の変形を規制し耐圧力を上げることができる。また内部に注入硬化されたウレタンゴム(11)で振動吸収性を良くすることができる。さらに、使用条件により、ニトリルゴム製のパイプ(12)と内部に注入されるウレタンゴム(11)の硬度の比率を適宜選択することにより、幅広い条件で使用できる。本実施例では、パイプの素材としてニトリルゴムを使用しているが、スチレンゴム、ウレタンゴム、クロロブレンゴム、ブチルゴム、エチレン・プロピレンゴム又はシリコンゴムに置き換えても同様の効果を得ることができる。

【００３２】実施例５．図７はこの実施例の可撓管の概略を示す側断面図である。図に示すように、冷媒配管としての吸入管(4)に溶接されたステンレス製の可撓管(9)に、予め可撓管(9)の外径よりも大きい塩化ビニル製のパイプ(13)を同心的に配設し、可撓管(9)と塩化ビニル製のパイプ(13)の隙間空間に液状のウレタンゴム(11)に鎖延長剤および架橋剤を混合した原料を注入硬化させると、塩化ビニル製のパイプ(13)と可撓管(9)との隙間空間にウレタンゴムの充填物が隙間なく存在するものが得られる。

【００３３】次に動作について説明する。可撓管(9)に冷媒が充填され、内圧が加えられたときに、可撓管(9)

の伸びがウレタンゴム(11)および塩化ビニル製のパイプ(13)により抑制される。また可撓管(9)の特定部分の応力がウレタンゴム(11)により集中せず、分散され可撓管(9)の耐圧性を向上することができる。また振動による応力もウレタンゴム(11)によって分散され、振動による応力集中、破壊を防止することができる。また、ウレタンゴム(11)の使用により、振動減衰に必要な可撓性を失うことなく可撓管(9)を補強できる。さらにウレタンゴム(11)の内部減衰により、振動時の減衰比も上り、可撓管に振動減衰機を取付けたのと同様の効果を達成できる。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる。また、この実施例でも可撓管の形状、寸法に合せて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので大きな金型を必要とすることなく端末シール部材を用いて製造できるので、耐圧振動吸収性にすぐれた低コストの可撓管を得ることができる。本実施例では、ニトリルゴムを使用しているが、スチレンゴム、ウレタンゴム、クロロプレンゴム、ブチルゴム、エチレン・プロピレンゴム又はシリコンゴムに置き換えても同様の効果を得ることができる。

【００３４】実施例６．図８は、この実施例の可撓管の概略を示す側断面図である。図８に示すように、冷媒配管としての吸入管(4)に溶接されたステンレス製の可撓管(9)に、予め可撓管(9)の外径よりも大きく内側がゴム製のメッシュ(14)で補強されたニトリルゴム製のパイプ(12)を同心的に配設し、可撓管(9)とニトリルゴム製のパイプ(12)の隙間空間に液状のウレタンゴム(11)に鎖延長剤および架橋剤を混合した原料を注入し硬化させると、ニトリルゴム製のパイプ(12)と可撓管(9)との隙間空間にウレタンゴムの充填物が隙間なく存在するものが得られる。

【００３５】次に動作について説明する。可撓管(9)に冷媒が充填され、内圧が加わった時に、可撓管(9)の伸びがゴム製のメッシュ(14)で補強されたニトリルゴム製のパイプ(12)により抑えられ、また、可撓管の特定部分に応力が集中せずに分散され、可撓管の耐圧性を向上することができる。また、ニトリルゴム製のパイプ(12)はゴム製のメッシュ(14)で補強されているので、実施例３、実施例４のニトリルゴム製のパイプとウレタンゴムを組み合わせた構造のものよりも、さらに高い耐圧性を得ることができる。また、振動による応力もウレタンゴム(11)によって分散され、振動による応力集中、破壊を防ぐことができる。さらにウレタンゴム(11)の内部減衰により振動時の振動減衰比も上り、可撓管に振動減衰機を取付けたのと同様の効果を得る。そのため冷媒配管の長さを短くでき、しかも冷媒配管を配設するスペースが小さくて済むため、ユニットの小型化が可能である。また、この実施例では可撓管の形状、寸法に合せて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので大きな金型を必要とすることなく、端末シール部材を用いて製造できるので、耐圧、振動吸収性にすぐれた低コストの可撓管を得ることができる。本実施例では、ニトリルゴムを使用しているが、スチレンゴム、ウレタンゴム、クロロプレンゴム、ブチルゴム、エチレン・プロピレンゴム又はシリコンゴムに置き換えても同様の効果を得ることができる。

【００３６】

【発明の効果】この発明は、以上説明したように構成されているので、以下に示すような効果を奏する。

【００３７】圧縮機と熱交換器との間に接続された冷媒配管の途中にステンレス製の可撓管が直列に接続された空気調和機用冷媒配管において、ベローズ状に形成されたステンレス製の可撓管の凹凸部および冷媒配管との溶接部の外面が、上記凹凸部に対応する凹凸部内面と円筒形外面とを有するゴムにより隙間なくカバーされている構成によれば、可撓性を失うことなく可撓管を補強し、耐圧曲げ応力に対する強度、振動吸収性を良くすることができる。したがって冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる効果を有する。また、可撓管と冷媒配管との接続部の外面がゴムによりカバーされていることにより、溶接部に腐食等が発生しにくくなる。

【００３８】また、ベローズ状に形成されたステンレス製の可撓管の凹凸部外面に対応する凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った分割体が上記可撓管の凹凸部外側に嵌着されている構成によれば、可撓性を失うことなく可撓管を補強し、耐圧性、曲げ応力に対する強度、振動吸収性を良くすることができる。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる効果を有する。さらに、上記凹凸部内面を有するニトリルゴム製のパイプの長手方向に沿った分割体は生産性が高く、組付け作業も簡単であるので製造コストを引き下げる効果がある。

【００３９】また、ベローズ状に形成されたステンレス製の可撓管と、その外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化して形成されたウレタンゴムの充填物が隙間なく存在し密着されている構成によれば、可撓性を失うことなく可撓管を補強し、耐圧性、曲げ応力に対する強度特性および振動吸収性が良くなる。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる。さらに、可撓管の形状、寸法に合せて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので、耐圧性振動吸収性にすぐれた可撓管を生産性を高めて低コストで得ること

11

ができる。

【００４０】また、ニトリルゴム製のパイプと内部に注入するウレタンゴムの硬度を変え、パイプを構成するニトリルゴムの硬度をウレタンゴムよりも硬くすることにより、可撓性を失うことなく可撓管を補強し、耐圧性、曲げ応力に対する強度特性および振動吸収性が向上する。そのため、冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくすることができるので、ユニットの小型化が可能となる。また生産性を高めて低コストで製作できる効果がある。

【００４１】また、ベローズ状に形成されたステンレス製の可撓管と、その外方に間隔をおいて同心的に配設された塩化ビニル製のパイプとの隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化して形成されたウレタンゴムの充填物が隙間なく存在し密着されている構成によれば、可撓性を失うことなく可撓管を補強し、耐圧性、曲げ応力に対する強度特性および振動吸収性が良くなる。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を配設するスペースを小さくできるため、ユニットの小型化が可能となる効果を有する。また、可撓管の形状、寸法に合せて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので、耐圧性、振動吸収性にすぐれた可撓管を生産性を高めて低コストで得ることができる。

【００４２】また、内側がゴム製のメッシュで補強され、ステンレス製のベローズ状の可撓管の外方に間隔をおいて同心的に配設されたニトリルゴム製のパイプと、上記可撓管との隙間空間へ液状のウレタンゴムを主体とする原料を注入硬化して形成されたウレタンゴムの充填物が隙間なく存在し密着されている構成によれば、可撓性を失うことなく可撓管を補強し、耐圧性、曲げ応力に対する強度特性、振動吸収性を良くすることができる。そのため冷媒配管の長さを短縮でき、しかも冷媒配管を＊

12

＊配設するスペースを小さくできるため、ユニットの小型化が可能となる効果を有する。さらに、可撓管の形状、寸法に合せて液状のウレタンゴムの注入によってウレタンゴムの充填物を得ることができるので、耐圧性振動吸収性にすぐれた可撓管を生産性を高めて低コストで得ることができる。

【図面の簡単な説明】

【図１】この発明の実施例１を示す全体の概略斜視図。

【図２】この発明の実施例１の可撓管を示す側断面図。

【図３】この発明の実施例２の可撓管の分解側面図。

【図４】この発明の実施例２の可撓管の側面図。

【図５】この発明の実施例３の可撓管の製造に関する説明図。

【図６】この発明の実施例３又は実施例４の可撓管の側断面図。

【図７】この発明の実施例５の可撓管の側断面図。

【図８】この発明の実施例６の可撓管の側断面図。

【図９】この発明の実施例１の可撓管有無の周波数と振動レベルの関係図。

【図１０】第一の従来例に関する配管構造を示す斜視図。

【図１１】第二の従来例に関する配管構造を示す斜視図。

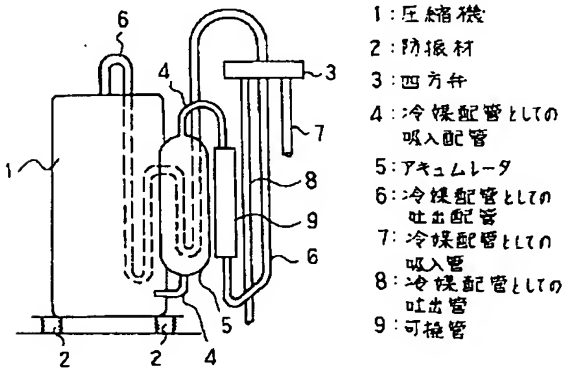
【図１２】図１１の可撓管を示す側面図。

【図１３】図１１の可撓管を示す側断面図。

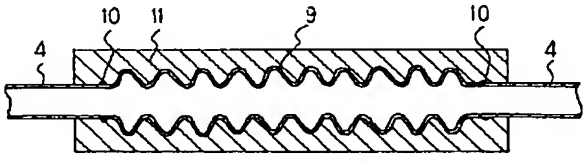
【符号の説明】

１　圧縮機、２　防振材、３　四方弁、４　冷媒配管としての吸入配管、５アキュムレータ、６　冷媒配管としての吐出配管、７　冷媒配管としての吸入管、８　冷媒配管としての吐出管、９　可撓管、１０　溶接部、１１　ウレタンゴム、１１ａ　ウレタンゴムの分割体、１２　ニトリルゴム製のパイプ、１３　塩化ビニル製のパイプ、１４　ゴム製のメッシュ。

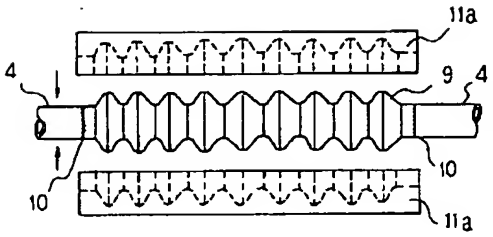
【図１】



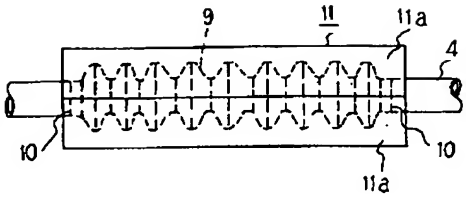
【図２】



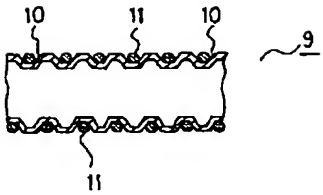
【図3】



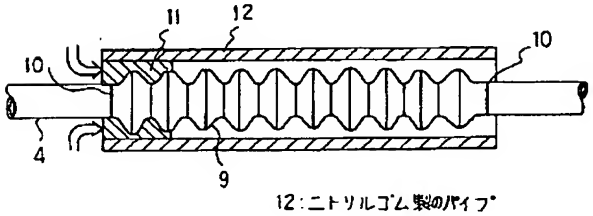
【図4】



【図13】

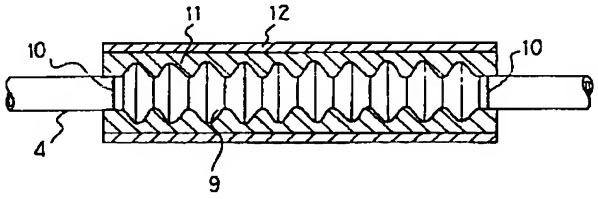


【図5】

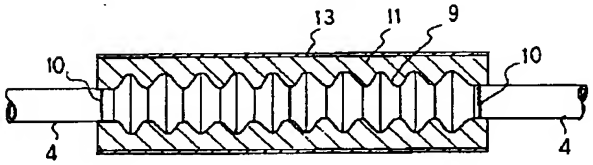


12：ニトリルゴム製のパイプ

【図6】

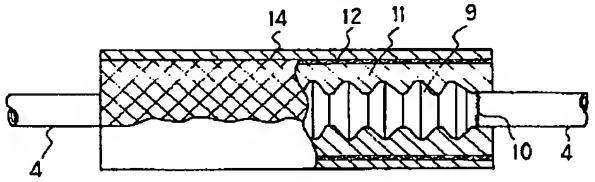


【図7】



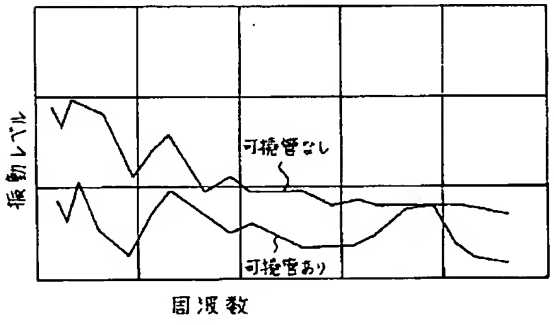
13：塩化ビニル製のパイプ

【図8】

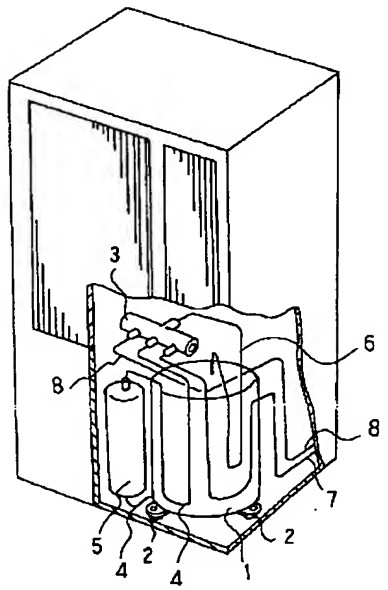


14：ゴム製のメッシュ

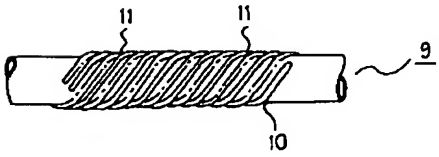
【図9】



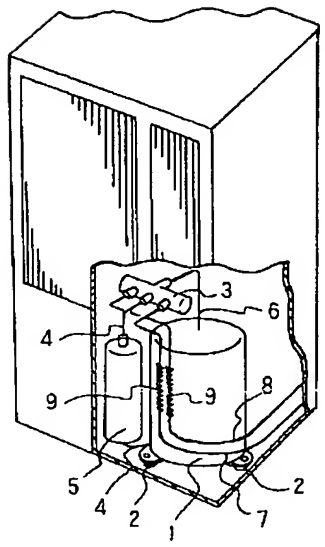
【図10】



【図12】



【図11】



フロントページの続き

(72)発明者　清水　克則
静岡市小鹿三丁目18番1号　三菱電機株式会社静岡製作所内

(72)発明者　手塚　與文
静岡市小鹿三丁目18番1号　三菱電機株式会社静岡製作所内

(72)発明者　磯部　豊
静岡市小鹿三丁目18番1号　三菱電機株式会社静岡製作所内